Amendments

In the Claims, kindly replace all prior versions, and listings, of claims in the application with the folowing:

1. (Previously presented) A computer implemented method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

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29. (Previously presented) A computer implemented method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to;

define at least one interior geometric shape that lies entirely within the first geometry;

define an approximation of the first geometry;

define an approximation of the second geometry; and

compare the approximation of the first geometry with the approximation of the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the first geometry and the second geometry by analyzing the distribution of the approximation of the second geometry with respect to the at least one interior geometric shape within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

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46. (Previously presented) A computer program product for performing a process of determining relationships among objects represented in a database, comprising:

a computer readable medium; and

computer program instructions, recorded on the computer readable medium, executable by a processor, for performing the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the

minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

47. (Previously presented) A system for performing a process of determining relationships among objects represented in a database, comprising:

a processor operable to execute computer program instructions; and

a memory operable to store computer program instructions executable by the processor, for performing the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter

operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

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56. (Currently Amended) A system for performing a process of determining relationships among objects represented in a database, comprising:

a processor operable to execute computer program instructions; and

a memory operable to store computer program instructions executable by the processor, for performing the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry; and

providing the first geometry and the second geometry to ~~an intermediate~~ a filter; and the ~~intermediate~~ filter operable to:

determine whether the second geometry fulfills ~~an intermediate~~ a filter condition comprising an interaction of at least one interior rectangle defined for the first geometry that lies entirely within the first geometry and a minimum bounding rectangle defined for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

include the second geometry in a final result set of objects that satisfy the desired relationship if the second geometry is confirmed as fulfilling the ~~intermediate~~ filter condition;

exclude the second geometry from the final result set that satisfy the desired relationship if the second geometry is confirmed as deviating from the ~~intermediate~~ filter condition; and

provide the first geometry and the second geometry to a secondary filter if the

second geometry cannot be confirmed as fulfilling, or deviating from, the ~~intermediate~~ filter condition.

57. (Currently Amended) A computer program product for performing a process of determining relationships among objects represented in a database, comprising:

a computer readable medium; and

computer program instructions, recorded on the computer readable medium, executable by a processor, for performing the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry; and

providing the first geometry and the second geometry to ~~an intermediate~~ a filter; and the ~~intermediate~~ filter operable to:

determine whether the second geometry fulfills ~~an intermediate~~ a filter condition comprising an interaction of at least one interior rectangle defined for the first geometry that lies entirely within the first geometry and a minimum bounding rectangle defined for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

include the second geometry in a final result set of objects that satisfy the desired relationship if the second geometry is confirmed as fulfilling the ~~intermediate~~ filter condition;

exclude the second geometry from the final result set that satisfy the desired

relationship if the second geometry is confirmed as deviating from the ~~intermediate~~ filter condition; and

provide the first geometry and the second geometry to a secondary filter if the second geometry cannot be confirmed as fulfilling, or deviating from, the ~~intermediate~~ filter condition.

58. (Currently Amended) A computer implemented method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry; and

providing the first geometry and the second geometry to ~~an intermediate~~ a filter operable to:

determine whether the second geometry fulfills ~~an intermediate~~ a filter condition comprising an interaction of at least one interior rectangle defined for the first geometry that lies entirely within the first geometry and a minimum bounding rectangle defined for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry; and

if the second geometry is confirmed as fulfilling the ~~intermediate~~ filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the ~~intermediate~~ filter

condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter.

59. (Previously presented) The method according to claim 58, wherein the first geometry and the second geometry comprise data geometries stored in a database.

60. (Previously presented) The method according to claim 58, wherein the first geometry comprises a data geometry stored in a database and the second geometry comprises a query geometry.

61. (Previously presented) The method according to claim 58, wherein the first geometry is larger than the second geometry.

62. (Previously presented) The method according to claim 58, wherein minimum bounding rectangles are defined for a plurality of second geometries.

63. (Previously presented) The method according to claim 58, wherein the first geometry is a collection of geometries each including a separate interior.

64. (Currently amended) The method according to claim 58, wherein providing the first geometry and the second geometry to ~~an intermediate~~ the filter is in response to the second geometry fulfilling a primary filter condition comprising any intersection between the minimum bounding rectangle for the first geometry and a minimum bounding rectangle defined for the second geometry.

65. (Previously presented) The method according to claim 58, wherein the at least one interior rectangle that lies entirely within the first geometry is defined by dividing the minimum bounding rectangle for the first geometry into a plurality of pieces and defining a largest possible interior rectangle lying completely within the first geometry and the plurality of pieces.

66. (Previously presented) The method according to claim 65, wherein the plurality of pieces are rectangles.

67. (Previously presented) The method according to claim 66, wherein the plurality of pieces are five rectangles having similar sizes.

68. (Previously presented) The method according to claim 66, wherein the minimum bounding rectangle for the first geometry is divided into four rectangles having similar sizes.

69. (Previously presented) The method according to claim 58, wherein a minimum bounding rectangle defined for the second geometry comprises a smallest rectangle that at most intersects a boundary of the second geometry.

70. (Currently amended) The method according to claim 58, wherein the ~~intermediate~~ filter condition is fulfilled if a minimum bounding rectangle defined for the second geometry lies entirely within the minimum bounding rectangle of the first geometry.

71. (Previously presented) The method according to claim 58, wherein the primary filter condition is one of:

a minimum bounding rectangle defined for the second geometry lying entirely within the minimum bounding rectangle of the first geometry;

the minimum bounding rectangle of the second geometry intersecting the minimum bounding rectangle of the first geometry;

a border of the minimum bounding rectangle of the second geometry touching a border of the minimum bounding rectangle of the first geometry;

the minimum bounding rectangle of the first geometry lying entirely within the minimum bounding rectangle of the second geometry; and

the minimum bounding rectangle of the second geometry is disjoint from the minimum bounding rectangle of the first geometry.

72. (Previously presented) The method according to claim 58, wherein the first geometry is

divided into five interior rectangles.

73. (Previously presented) The method according to claim 58, wherein one of the first geometry and the second geometry comprise objects in a database.

74. (Previously presented) The method according to claim 73, wherein the objects in the database comprises locations in a geographic region.

75. (Previously presented) The method according to claim 73, wherein the database is organized in an R-tree hierarchy.

76. (Previously presented) The method according to claim 73, wherein the database comprises a spatial database.

77. (Previously presented) The method according to claim 73, wherein the first geometry and the second geometry comprise objects on a surface.

78. (Previously presented) The method according to claim 77, wherein the database stores exact geometries and approximations of geometries.

79. (Previously presented) The method according to claim 60, wherein determining whether the first geometry and the second geometry fulfill the secondary filter condition comprises

mathematically comparing the fist geometry and the second geometry.

80. (Previously presented) The method according to claim 60, wherein the secondary filter condition is fulfilled if the first geometry and the second geometry overlap.

81. (Previously presented) The method according to claim 60, wherein the secondary filter condition is fulfilled if a boundary of the first geometry touches a boundary of the second geometry.

82. (Previously presented) The method according to claim 60, wherein the secondary filter condition is fulfilled if the first geometry and the second geometry intersect.

83. (Previously presented) The method according to claim 58, wherein at least one of the first geometry and the second geometry is convex.

84. (Previously presented) The method according to claim 83, wherein at least one of the first geometry and the second geometry comprises a plurality of separate interiors.

85. (Previously presented) The method according to claim 58, wherein at least one of the first geometry and the second geometry is concave.

86. (Canceled).

87. (Canceled).

88. (Previously presented) A method according to claim 60, further comprising providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry ; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship, otherwise excluding the second geometry from the final result set of objects that satisfy the desired relationship.

89. (Currently amended) A computer implemented method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry;

providing the first geometry and the second geometry to ~~an intermediate~~ a filter operable to:

determine whether the second geometry fulfills ~~an intermediate~~ a filter condition comprising an interaction of at least one interior rectangle defined for the first geometry that lies entirely within the first geometry and a minimum bounding rectangle defined for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry; and

if the second geometry is confirmed as fulfilling the ~~intermediate~~ filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the ~~intermediate~~ filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter.

90. (Previously presented) The method according to claim 89 further comprising providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry; and

define a minimum bounding rectangle for the second geometry,

91. (Previously presented) The method according to claim 90, wherein the primary filter is operable to compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry.

92. (Previously presented) A method according to claim 91, wherein the secondary filter is operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry ; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship, otherwise excluding the second geometry from the final result set of objects that satisfy the desired relationship.

93. (Previously presented) The method according to claim 89, wherein at least one of the first geometry and the second geometry is convex.

94. (Previously presented) The method according to claim 93, wherein at least one of the first geometry and the second geometry comprises a plurality of separate interiors.

95. (Previously presented) The method according to claim 89, wherein at least one of the first geometry and the second geometry is concave.

96. (Previously presented) The method according to claim 95, wherein concave geometries are approximated utilizing convex pieces.

97. (Previously presented) The method according to claim 95, wherein concave geometries are approximated utilizing tiles.

98. (Previously presented) The method according to claim 97, wherein a minimum bounding rectangle is tiled and tiles interior to the geometry are identified.

99. (Previously presented) The method according to claim 97, wherein the tiling level is 5.

100. (Previously presented) The method according to claim 97, wherein the tiling level is 4.

101. (Previously presented) The method according to claim 97, wherein the tiling level is 3.

102. (Previously presented) The method according to claim 97, further comprising determining whether a primary filter condition is fulfilled by comparing interior tiles.

103. (Previously presented) The method according to claim 95, wherein the approximation of the first geometry comprises a minimum bounding rectangle and an approximation defined for the second geometry comprises a minimum bounding rectangle and wherein comparing the interior tiles comprises:

dividing the second geometry minimum bounding rectangle into tiles;

assigning X and Y values to the tiles;

determining which tiles lie interior to the second geometry;

determining X and Y location of each tile;

storing the interior tiles in an array ordered first by X location;

storing the interior tiles in an array ordered first by Y location; and

comparing at least one of the tiles or the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry to determine the relationships among the geometries.

104. (Previously presented) The method according to claim 103, wherein comparing the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry comprises determining whether each side of the minimum bounding rectangle of

first geometry is inside the interior tiles of the second geometry which comprises:

determining X and Y locations within the tiles of corners of the minimum bounding rectangle of the first geometry;

determining X and Y locations within the tiles of second geometry for two corners of each side of the first geometry; and

determining whether all tiles between the two corners of each side of the first geometry are interior to the second geometry by comparing a difference in an x-location or a y-locations of the two corners to the number of interior tiles between these two corners.

105. (Previously presented) The method according to claim 104, wherein whether the x-location or the y-location is compared depends upon whether the side is parallel to y-axis or x-axis.

106. (Previously presented) The method according to claim 104, wherein the second geometry is not a simple polygon.

107. (Previously presented) The method according to claim 103, wherein comparing the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry comprises determining whether each side of the minimum bounding rectangle of first geometry is inside the interior tiles of the second geometry which comprises:

determining X and Y locations within the tiles of corners of the minimum

bounding rectangle of the first geometry;

determining X and Y locations within the tiles of second geometry for two corners of line interior to the MBR of the first geometry; and

determining whether all tiles between the two corners any line interior to the MBR of the first geometry are interior to the second geometry by comparing a difference in an x-location or a y-locations of the two corners to the number of interior tiles between these two corners.

108. (Previously presented) The method according to claim 104, wherein the second geometry is a compound geometry comprising multiple polygons or a geometry comprising holes, and wherein determining if the minimum bounding rectangle of the first geometry is interior to the interior tiles of second geometry by comparing the interior of the minimum bounding rectangle of first geometry to the interior tiles of second geometry.